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**A Biological Assessment of Stream Sites in Collar
Gulch and Chicago Gulch, Fergus County, Montana
TMDL-M26 August 18-20, 2003**

By W. Bollman
2004



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**A BIOLOGICAL ASSESSMENT OF STREAM SITES
IN COLLAR GULCH AND CHICAGO GULCH,
FERGUS COUNTY, MONTANA**

TMDL-M26

August 18 - 20, 2003

A report to

**The Montana Department of Environmental Quality
Planning, Prevention and Assistance Division
Helena, Montana
Rebecca Ridenour, Project Manager**

by

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March 2004**



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INTRODUCTION

Aquatic invertebrates are aptly applied to bioassessment since they are known to be important indicators of stream ecosystem health (Hynes 1970). Long lives, complex life cycles and limited mobility mean that there is ample time for the benthic community to respond to cumulative effects of environmental perturbations. This report summarizes data collected in August 18 - 20, 2003 from 5 sites in Collar Gulch and Chicago Gulch. Sites were located in Fergus County, Montana and lie within the Northern Rockies ecoregion (Woods et al. 1999).

A multimetric approach to bioassessment such as the one applied in this study uses attributes of the assemblage in an integrated way to measure biotic health. A stream with good biotic health is "...a balanced, integrated, adaptive system having the full range of elements and processes that are expected in the region's natural environment..." (Karr and Chu 1999). The approach designed by Plafkin et al. (1989) and adapted for use in the State of Montana has been defined as "... an array of measures or metrics that individually provide information on diverse biological attributes, and when integrated, provide an overall indication of biological condition." (Barbour et al. 1995). Community attributes that can contribute meaningfully to interpretation of benthic data include assemblage structure, sensitivity of community members to stress or pollution, and functional traits. Each metric component contributes an independent measure of the biotic integrity of a stream site; combining the components into a total score reduces variance and increases precision of the assessment (Fore et al. 1996). Effectiveness of the integrated metrics depends on the applicability of the underlying model, which rests on a foundation of three essential elements (Bollman 1998a). The first of these is an appropriate stratification or classification of stream sites, typically by ecoregion. Second, metrics must be selected based upon their ability to accurately express biological condition. Third, an adequate assessment of habitat conditions at each site to be studied enhances the interpretation of metric outcomes.

Implicit in the multimetric method and its associated habitat assessment is an assumption of correlative relationships between habitat measures and the biotic metrics, in the absence of water quality impairment. These relationships may vary regionally, requiring an examination of habitat assessment elements and biotic metrics and a test of the presumed relationship between them. Bollman (1998a) studied the assemblages of the Montana Valley and Foothill Prairies (MVFP) ecoregion and has recommended a battery of metrics applicable to the montane ecoregions of western Montana. This metric battery has been shown to be sensitive to impairment, related to measures of habitat integrity, and consistent over replicated samples. However, scoring criteria developed for the MVFP ecoregion metric battery may not be appropriately sensitive for streams of the Northern Rockies ecoregion. Additional work may be needed to calibrate scoring to montane regions, thus impairment classifications must be interpreted with care. For comparison, the bioassessment index found in the Montana Department of Environmental Quality (Montana DEQ) Standard Operating Procedures (Bukantis 1998) is also scored and presented. However, this index has not been tested for sensitivity to impairment, relationship to measures of habitat integrity, or consistency over replicated samples.

In this report, 3 assessment methods are used: first, taxonomic data is translated in to 2 bioassessment indices, and metric scores in each index are summed to derive impairment classifications and use support designations. Second, a narrative interpretation, based on the author's professional judgment is given. Metric performance and taxonomic data are both applied to this analysis. Third, the model of Barbour and Stribling (1991) is applied to bioassessment and habitat assessment scores. While the interdependence of these methods is obvious, since the same data are used for all, some degree of independence is maintained throughout the analysis. Narrative interpretations are given without regard to the bioassessment index result, and without reference to habitat assessment. Since indices are summations, they can

often mask evidence of impairment; the narratives attempt to expose the potential shortcomings of the indices. Similarly, graphing the association between habitat assessment scores and bioassessment scores using the model of Barbour and Stribling can provide clues to offer support or possible refutation of the conclusions of the narrative analysis.

METHODS

Samples were collected in August 18 - 20, 2003 by personnel of Montana DEQ. Sample designations and site locations are indicated in Table 1 and on Figure 1. The site selection and kicknet sampling method employed were those recommended in the Montana DEQ Standard Operating Procedures for Aquatic Macroinvertebrate Sampling (Bukantis 1998). Aquatic invertebrate samples were delivered to Rhithron Associates, Inc., Missoula, Montana, for laboratory and data analyses. In the laboratory, the Montana DEQ-recommended sorting method was used to obtain subsamples of at least 300 organisms from each sample, when possible. Organisms were identified to the lowest possible taxonomic levels consistent with Montana DEQ protocols.

Table 1. Sample designations and locations. Sites are listed in upstream-to-downstream order. Collar Gulch and Chicago Gulch. August 18 - 20, 2003.

Site ID	Station ID	Activity ID	Location Description	Collection Date	Latitude	Longitude
COLRG 1	M26COLRG01	03-L498-M	Collar Gulch at headwaters	08/18/03	47°-12'-44"	109°-12'-11"
COLRG 2	M26COLRG02	03-L499-M	Collar Gulch near Collar Peak	08/18/03	47°-12'-12"	109°-12'-20"
COLRG 3	M26COLRG03	03-L518-M	Collar Gulch near GS camp	08/20/03	47°-11'-37"	109°-11'-58"
CHGOT 1	M26CHGOT01	03-L514-M	Tributary to Chicago Gulch	08/19/03	47°-12'-38"	109°-10'-50"
CHGOG 2	M26CHGOG02	03-L516-M	Chicago Gulch near lower BLM boundary	08/19/03	47°-12'-20"	109°-09'-51"

Two bioassessment indices were employed in evaluating the data. The first index employed was developed for streams of western Montana ecoregions (Bollman 1998a). Each metric used in this index was tested for its response or sensitivity to varying degrees of human influence. Correlations have been demonstrated between the metrics and various symptoms of human-caused impairment as expressed in water quality parameters or instream, streambank, and stream reach morphologic features. Metrics were screened to minimize variability over natural environmental gradients, such as site elevation or sampling season, which might confound interpretation of results (Bollman 1998a). The multimetric index incorporates multiple attributes of the sampled assemblage into an integrated score that accurately describes the benthic community of each site in terms of its biologic integrity. In addition to the metrics included in the index, other metrics shown to be applicable to biomonitoring in other regions (Kleindl 1995, Patterson 1996, Rossano 1995) were used for descriptive interpretation of results. These metrics include the number of "clinger" taxa, long-lived taxa richness, the percent of predatory organisms, and others. They are not included in the integrated bioassessment score, however, since their performance in western Montana ecoregions is unknown. However, the relationship of these metrics to habitat conditions is intuitive and reasonable.

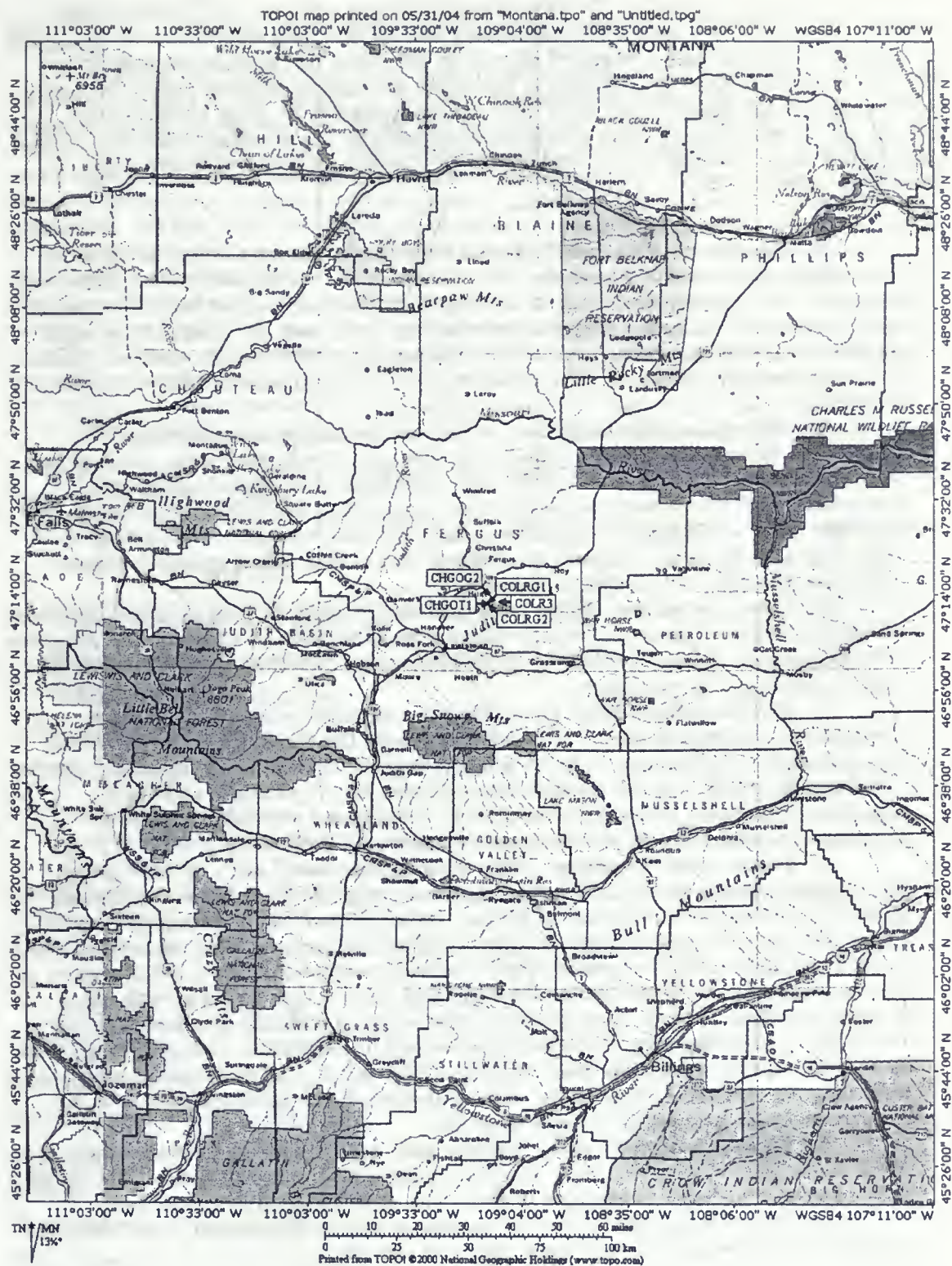


Figure 1. Approximate locations of sampling sites. Collar Gulch and Chicago Gulch, August 18-20, 2003.

The six metrics included in the bioassessment index used for MVFP sites in this study were selected because, both individually and as an integrated metric battery, they are robust at distinguishing impaired sites from relatively unimpaired sites (Bollman 1998a). In addition, they are relevant to the kinds of impacts that are present in Collar Gulch and Chicago Gulch. They have been demonstrated to be more variable with anthropogenic disturbance than with natural environmental gradients (Bollman 1998a). Each of the six metrics developed and tested for western Montana ecoregions is described below.

1. Ephemeroptera (mayfly) taxa richness. The number of mayfly taxa declines as water quality diminishes. Impairments to water quality which have been demonstrated to adversely affect the ability of mayflies to flourish include elevated water temperatures, heavy metal contamination, increased turbidity, low or high pH, elevated specific conductance and toxic chemicals. Few mayfly species are able to tolerate certain disturbances to instream habitat, such as excessive sediment deposition.

2. Plecoptera (stonefly) taxa richness. Stoneflies are particularly susceptible to impairments that affect a stream on a reach-level scale, such as loss of riparian canopy, streambank instability, channelization, and alteration of morphological features such as pool frequency and function, riffle development and sinuosity. Just as all benthic organisms, they are also susceptible to smaller scale habitat loss, such as by sediment deposition, loss of interstitial spaces between substrate particles, or unstable substrate.

3. Trichoptera (caddisfly) taxa richness. Caddisfly taxa richness has been shown to decline when sediment deposition affects habitat. In addition, the presence of certain case-building caddisflies can indicate good retention of woody debris and lack of scouring flow conditions.

4. Number of sensitive taxa. Sensitive taxa are generally the first to disappear as anthropogenic disturbances increase. The list of sensitive taxa used here includes organisms sensitive to a wide range of disturbances, including warmer water temperatures, organic or nutrient pollution, toxic pollution, sediment deposition, substrate instability and others. Unimpaired streams of western Montana typically support at least four sensitive taxa (Bollman 1998a).

5. Percent filter feeders. Filter-feeding organisms are a diverse group; they capture small particles of organic matter, or organically enriched sediment material, from the water column by means of a variety of adaptations, such as silken nets or hairy appendages. In forested montane streams, filterers are expected to occur in insignificant numbers. Their abundance increases when canopy cover is lost and when water temperatures increase and the accompanying growth of filamentous algae occurs. Some filtering organisms, specifically the Arctopsychid caddisflies (*Arctopsyche* spp. and *Parapsyche* spp.) build silken nets with large mesh sizes that capture small organisms such as chironomids and early-instar mayflies. Here they are considered predators, and, in this study, their abundance does not contribute to the percent filter feeders metric.

6. Percent tolerant taxa. Tolerant taxa are ubiquitous in stream sites, but when disturbance increases, their abundance increases proportionately. The list of taxa used here includes organisms tolerant of a wide range of disturbances, including warmer water temperatures, organic or nutrient pollution, toxic pollution, sediment deposition, substrate instability and others.

The second index used here is the metric battery recommended in the Montana DEQ standard operating procedures (Bukantis 1998). These metrics should be considered provisional, since correlative relationships between them and meaningful measures of habitat condition and water quality have not been evaluated. Thus,

conclusions concerning bioassessment based upon these metrics must be regarded as tentative.

Scoring criteria for each of the metrics are presented in Tables 2a and 2b. Table 2a gives metrics and criteria for the revised bioassessment index (Bollman 1998a) and Table 2b gives metrics and criteria for the Montana DEQ method (Bukantis 1998). Metrics differ in their possible value ranges as well as in the direction the values move as biological conditions change. For example, Ephemeroptera richness values may range from zero to ten taxa or higher. Larger values generally indicate favorable biotic conditions. On the other hand, the percent filterers metric may range from 0% to 100%; in this case, larger values are negative indicators of biotic health. To facilitate scoring, therefore, metric values were transformed into a single scale. The range of each metric has been divided into four parts and assigned a point score between zero and three. A score of three indicates a metric value similar to one characteristic of a non-impaired condition. A score of zero indicates strong deviation from non-impaired condition and suggests severe degradation of biotic health. Scores for each metric were summed to give an overall score, the total bioassessment score, for each site in each sampling event. These scores were expressed as the percent of the maximum possible score. The

Table 2a. Metrics and scoring criteria for bioassessment of montane streams of Western Montana (Bollman 1998a).

Metric	Score			
	3	2	1	0
Ephemeroptera taxa richness	> 5	5 - 4	3 - 2	< 2
Plecoptera taxa richness	> 3	3 - 2	1	0
Trichoptera taxa richness	> 4	4 - 3	2	< 2
Sensitive taxa richness	> 3	3 - 2	1	0
Percent filterers	0 - 5	5.01 - 10	10.01 - 25	> 25
Percent tolerant taxa	0 - 5	5.01 - 10	10.01 - 35	> 35

Table 2b. Provisional metrics and scoring criteria for bioassessment of streams of the Mountain Ecoregions (Bukantis 1998).

Metric	Score			
	3	2	1	0
Taxa richness	> 28	28 - 24	24 - 19	< 19
EPT richness	> 19	19 - 17	17 - 15	< 15
Biotic index	< 3	3 - 4	4 - 5	> 5
% dominant taxon	< 25	25 - 35	35 - 45	> 45
% collector	< 60	60 - 70	70 - 80	> 80
% scraper + shredder	> 55	55 - 40	40 - 25	< 25
% EPT	> 70	70 - 55	55 - 40	< 40

Table3a. Criteria for the assignment of use-support classifications / standards violation thresholds (Bukantis 1998).

% Comparability to reference	Use support
>75	Full support--standards not violated
25-75	Partial support--moderate impairment--standards violated
<25	Non-support--severe impairment--standards violated

Table3b. Criteria for the assignment of impairment classifications (Plafkin et al. 1989).

% Comparability to reference	Classification
> 83	nonimpaired
54-79	slightly impaired
21-50	moderately impaired
<17	severely impaired

total bioassessment score for each site was expressed in terms of use-support. Criteria for use-support designations were developed by Montana DEQ and are presented in Table 3a. Scores were also translated into impairment classifications according to criteria outlined in Table 3b.

In the narrative portion of this report, certain other metrics were used as descriptors of the benthic community response to habitat or water quality; these metrics were not incorporated into the revised bioassessment index, either because they have not yet been tested for reliability in streams of western Montana, or because results of such testing did not show them to be robust at distinguishing impairment, or because they did not meet other requirements for inclusion in the metric battery. These metrics and their use in predicting the causes of impairment or in describing its effects on the biotic community are described below.

- The modified biotic index. This metric is an adaptation of the Hilsenhoff Biotic Index (HBI, Hilsenhoff 1987), which was originally designed to indicate organic enrichment of waters. Values of this metric are lowest in least impacted conditions. Taxa tolerant to saprobic conditions are also generally tolerant of warm water, fine sediment and heavy filamentous algae growth (Bollman 1998b). Loss of canopy cover is often a contributor to higher biotic index values. The taxa values used in this report are modified to reflect habitat and water quality conditions in Montana (Bukantis 1998). Ordination studies of the benthic fauna of Montana's foothill prairie streams showed that there is a correlation between modified biotic index values and water temperature, substrate embeddedness, and fine sediment (Bollman 1998a). In a study of reference streams, the average value of the modified biotic index in least-impaired streams of western Montana was 2.5 (Wisseman 1992).
- Taxa richness. This metric is a simple count of the number of unique taxa present in a sample. Average taxa richness in samples from reference streams in western Montana was 28 (Wisseman 1992). Taxa richness is an expression of biodiversity, and generally decreases with degraded habitat or diminished water quality. However, taxa richness may show a paradoxical increase when mild nutrient enrichment occurs in previously oligotrophic waters, so this metric must be interpreted with caution.

- Percent predators. Aquatic invertebrate predators depend on a reliable source of invertebrate prey, and their abundance provides a measure of the trophic complexity supported by a site. Less disturbed sites have more plentiful habitat niches to support diverse prey species, which in turn support abundant predator species.
- Number of “clinger” taxa. So-called “clinger” taxa have physical adaptations that allow them to cling to smooth substrates in rapidly flowing water. Aquatic invertebrate “clingers” are sensitive to fine sediments that fill interstices between substrate particles and eliminate habitat complexity. Animals that occupy the hyporheic zones are included in this group of taxa. Expected “clinger” taxa richness in unimpaired streams of western Montana is at least 14 (Bollman 1998b).
- Number of long-lived taxa. Long-lived or semivoltine taxa require more than a year to completely develop, and their numbers decline when habitat and/or water quality conditions are unstable. They may completely disappear if channels are dewatered or if there are periodic water temperature elevations or other interruptions to their life cycles. Western Montana streams with stable habitat conditions are expected to support six or more long-lived taxa (Bollman 1998b).

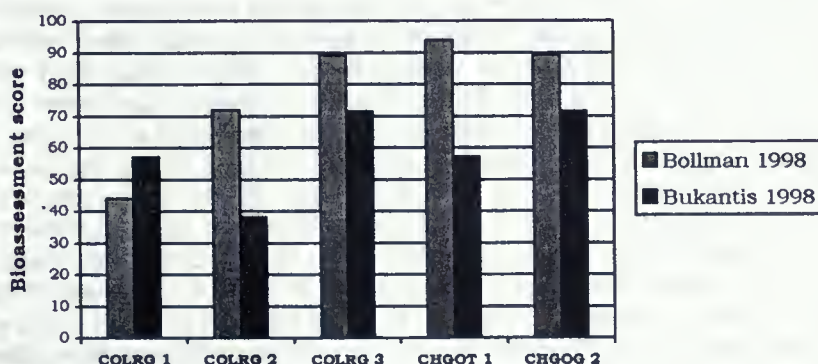
RESULTS

Bioassessment

Samples collected at 2 of the sites in Collar Gulch, sites COLRG 1 and COLRG 2 each yielded too few animals to allow for reliable bioassessment. Thus, neither of these sites is treated further in the discussion. Scores and classifications for these 2 sites given in Figure 2 and Tables 4a and 4b are not intended to be interpreted as accurate bioassessments.

Figure 2 summarizes bioassessment scores for aquatic invertebrate communities sampled from sites in Collar Gulch and Chicago Gulch, and compares the results of the 2 indices employed. The methods gave differing results when applied to these data. In all 3 cases where sample sizes were adequate, the revised index gave considerably higher scores than the Montana DEQ index. The revised index indicated that the 3 sites were non-impaired and fully supportive of designated uses, while the Montana DEQ index indicated slight impairment and partial use support at all 3 sites.

Figure 2. Comparison of total bioassessment scores (reported as percent of maximum score). The revised bioassessment index (Bollman 1998a) was used to calculate scores represented by green bars, and the Montana DEQ battery (Bukantis 1998) was used to calculate scores represented by purple bars. Collar Gulch and Chicago Gulch. August 18 - 20, 2003. Sites COLRG 1 and COLRG 2 yielded too few animals for reliable bioassessment.



Aquatic invertebrate communities

Interpretations of biotic integrity in this report are made without reference to results of habitat assessments, or any other information about the sites or watersheds that may have accompanied the invertebrate samples. Interpretations are based entirely on: the taxonomic and functional composition of the sampled invertebrate assemblages; the sensitivities, tolerances, physiology, and habitus information for individual taxa gleaned from the writer's research; the published literature, and other expert sources; and on the performance of bioassessment metrics, described earlier in the report, which have been demonstrated to be useful tools for interpreting potential implications of benthic invertebrate assemblage composition.

Collar Gulch

The upper 2 sampled sites in Collar Gulch yielded samples with too few organisms for reliable bioassessment. The sample from the site at the headwaters (COLRG 1) contained only 18 animals; the sample from the site near Collar Peak (COLRG 2) contained only 181 animals. Small sample sizes, given adequate sampling effort and appropriate choice of sampling location, can reflect poor habitat and/or water quality conditions.

Near the GS camp, Collar Gulch (COLRG 3) yielded a sample with 4 mayfly taxa; the biotic index value calculated for the assemblage as a whole was 3.38. Mayfly taxa richness was somewhat lower than expected for a montane stream, and the biotic index value was somewhat higher than expected. These findings suggest that water quality may have been impaired by mild nutrient enrichment. Thermal challenge by warm temperatures seems unlikely; the site supported at least 3 cold stenotherm taxa, including the stonefly *Doroneuria* sp. The presence of abundant turbellarian worms, *Polycelis coronata*, suggests that groundwater inputs contribute to surface flow in this reach.

Nine "clinger" taxa and 4 caddisfly taxa occurred in the sample; both values are lower than expected, and could indicate that sediment deposition limits the availability of hard substrate habitats. Overall taxa richness (31) was high enough to suggest that other instream habitats were complex. Six stonefly taxa were collected. The richness of this group may be associated with reach-scale habitat features such as streambank stability, riparian zone integrity, and natural channel morphology. It seems unlikely that the reach suffered recent dewatering or other catastrophes that would limit long life cycles, since 3 semivoltine taxa were counted. All expected functional groups were present; the abundance of shredders was notable. This may indicate that riparian inputs of large organic debris were ample, and that hydrologic and channel conditions at the site favored retention of such material.

Chicago Gulch

At the site on the tributary to Chicago Gulch (CHGOt 1), the benthic collection contained 5 mayfly taxa, slightly fewer than expected for a montane stream. The biotic index value (4.34) was considerably elevated compared to anticipated values. However, the abundance of the midge *Cricotopus nostococladius*, which dominated the sample collected at this site, appears to have driven this value higher than water quality conditions may have warranted. This animal has been assigned a tolerance value of 6 in the Montana DEQ Standard Operating Procedure (Bukantis 1998), but is considered by many biologists to be a sensitive taxon (e.g. Wisseman 1996). If *C. nostococladius* is excluded from the calculation, the value falls to 3.05, which still indicates that water quality may have been mildly impaired by slight nutrient enrichment. Warm water temperatures are unlikely, since the site supported at least 4 cold stenotherm taxa.

Eleven "clinger" taxa were collected, which is somewhat fewer than expected, but 7 caddisfly taxa were present. It seems unlikely that fine sediment deposition severely limited clean stony habitats, but some contamination by deposition cannot be ruled

out. At least 37 taxa inhabited the sampled site; instream habitats were probably complex and available. Reach-scale habitat features may have been generally intact, since the stonefly fauna was rich (5 taxa). Long-lived taxa were well-represented; six were collected. This finding implies that surface flow persisted in the reach year-round, and that other catastrophes such as toxic inputs or scouring sediment pulses, that would abort long life cycles, were unlikely. Shredders dominated the functional mix; most of these were *C. nostococladius*, the abundance of which is not tied to riparian inputs of allochthonous material.

The sample collected from Chicago Gulch near the lower BLM boundary contained only 4 mayfly taxa, and the biotic index calculated for the sampled assemblage was 3.53. These findings suggest that water quality was not as good as expected for a montane stream. Nutrient enrichment may have impaired biotic integrity to a slight extent. Water temperatures were probably cold, since numerous *Doroneuria* sp. were collected here.

Fourteen "clinger" taxa and 7 caddisfly taxa were present in the sample; sediment deposition probably did not limit stony substrate habitats. Overall taxa richness (35) was high enough to suggest that diverse instream habitats were available. The site supported at least 7 stonefly taxa, which implies that reach-scale habitats may have been undisturbed. Five long-lived taxa were counted, indicating that surface flow likely persisted year-round. The functional composition of the assemblage included all expected elements. The abundance of shredders, notably the nemourid stonefly *Zapada cinctipes*, was high, suggesting ample inputs of large organic debris from riparian sources.

CONCLUSIONS

- Two sites in Collar Gulch (COLRG 1 and COLRG 2) yielded samples with too few animals to give reliable bioassessment results.
- At the GS camp (COLRG 3) Collar Gulch supported a benthic assemblage that suggested slight nutrient enrichment and some habitat limitations due to sediment deposition.
- Evidence of mild nutrient enrichment may be discerned in overall assemblage tolerances at sites on CHGCT 1 AND CHGOG 2.

Table 4a. Metric values, scores, and bioassessments for 5 sites in Collar Gulch and Chicago Gulch. August 18 - 20, 2003. Site locations are given in Table 1. The revised bioassessment method (Bollman 1998a) was used to calculate scores. Scores and classifications in *italics* indicate samples with too few animals for reliable bioassessment.

	SITES				
	COLRG 1	COLRG 2	COLRG 3	CHGOT 1	CHGOG 2
METRICS	METRIC VALUES				
Ephemeroptera richness	0	2	4	5	4
Plecoptera richness	2	4	6	5	7
Trichoptera richness	2	2	4	7	7
Number of sensitive taxa	1	2	4	5	3
% filterers	0.00	0.00	0.00	0.31	4.47
% tolerant taxa	33.33	1.10	0.00	2.79	1.68
	METRIC SCORES				
Ephemeroptera richness	0	1	2	2	2
Plecoptera richness	2	3	3	3	3
Trichoptera richness	1	1	2	3	3
Number of sensitive taxa	1	2	3	3	2
% filterers	3	3	3	3	3
% tolerant taxa	1	3	3	3	3
TOTAL SCORE (max.=18)	8	13	16	17	16
PERCENT OF MAX.	44	72	89	94	89
Impairment classification*	MOD	SLI	NON	NON	NON
USE SUPPORT †	PART	PART	FULL	FULL	FULL

* Impairment classifications: (NON) non-impaired, (SLI) slightly impaired, (MOD) moderately impaired, (SEV) severely impaired. See Table 3b.† Use support designations: See Table 3a.

Table 4b. Metric values, scores, and bioassessments for 5 sites in Collar Gulch and Chicago Gulch. August 18 - 20, 2003. Site locations are given in Table 1. The Montana DEQ bioassessment method (Bukantis 1998) was used to calculate scores. Scores and classifications in *italics* indicate samples with too few animals for reliable bioassessment.

	SITES				
	COLRG 1	COLRG 2	COLRG 3	CHGOT 1	CHGOG 2
	METRIC VALUES				
Taxa richness	7	22	31	37	35
EPT richness	4	8	14	16	17
Biotic index	3.22	4.20	3.38	4.34	3.53
% dominant taxon	38.89	33.15	16.21	43.65	33.24
% collector	5.56	40.33	12.84	26.01	48.04
% EPT	83.33	40.88	55.66	30.65	58.38
% scraper + shredder	77.78	16.02	45.57	62.23	39.66
	METRIC SCORES				
Taxa richness	0	1	3	3	3
EPT richness	0	0	0	1	2
Biotic index	2	1	2	1	2
% dominant taxon	1	2	3	1	2
% collector	3	3	3	3	3
% EPT	3	1	2	0	2
% scraper + shredder	3	0	2	3	1
TOTAL SCORE (max.=21)	12	8	15	12	15
PERCENT OF MAX.	57.14	38.10	71.43	57.14	71.43
Impairment classification*	<i>SLI</i>	<i>MOD</i>	<i>SLI</i>	<i>SLI</i>	<i>SLI</i>
USE SUPPORT †	<i>PART</i>	<i>PART</i>	<i>PART</i>	<i>PART</i>	<i>PART</i>

* Impairment classifications: (NON) non-impaired, (SLI) slightly impaired, (MOD) moderately impaired, (SEV) severely impaired. See Table 3b.† Use support designations: See Table 3a.

Habitat Assessment

Figure 3 graphically compares total habitat assessment scores recorded for the 5 sites in this study. Table 5 shows the habitat parameters evaluated, parameter scores, and overall habitat evaluations for the sites studied.

Figure 3. Total habitat assessment scores for sites on Collar Gulch and Chicago Gulch. August 18 - 20, 2003

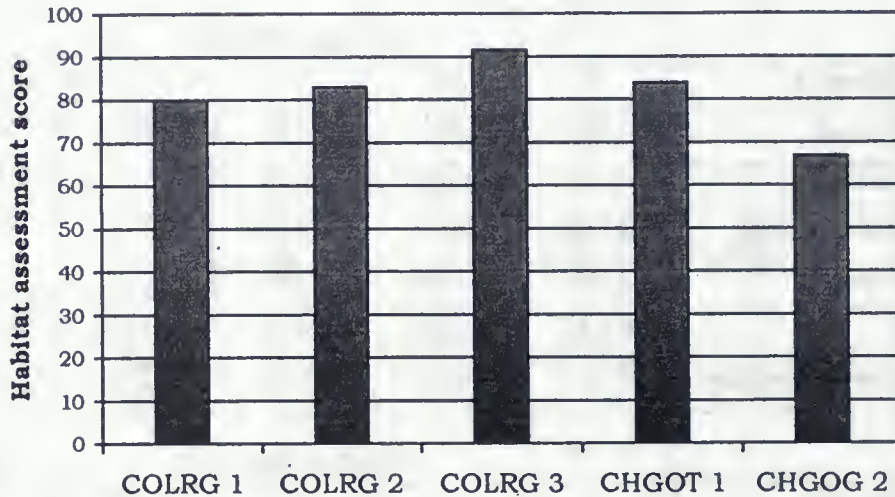


Table 5. Stream and riparian habitat assessment. Sites were assessed based upon criteria developed by Montana DEQ for streams with riffle/run prevalence. Collar Gulch and Chicago Gulch. August 18 - 20, 2003.

Max. possible score	Parameter	SITES				
		COLRG 1	COLRG 2	COLRG 3	CHGOT 1	CHGOG 2
10	Riffle development	8	6	10	10	10
10	Benthic substrate	5	6	10	9	8
20	Embeddedness	18	20	17	17	17
20	Channel alteration	18	20	18	17	11
20	Sediment deposition	20	20	18	17	15
20	Channel flow status	8	8	18	17	17
20	Bank stability	7 / 10	9 / 9	9 / 9	10 / 10	3 / 3
20	Bank vegetation	10 / 10	9 / 9	9 / 9	9 / 7	3 / 3
20	Vegetated zone	7 / 10	10 / 10	10 / 10	5 / 3	3 / 3
160	Total	104	108	119	109	87
	Percent of maximum CONDITION*	80.00	83.03	91.54	83.85	66.92
		OPT	OPT	OPT	OPT	SUB- OPT

* Condition categories: Optimal > 80% of maximum score; Sub-optimal 75 - 56%; Marginal 49 - 29%; Poor <23%. Plafkin et al. 1989.

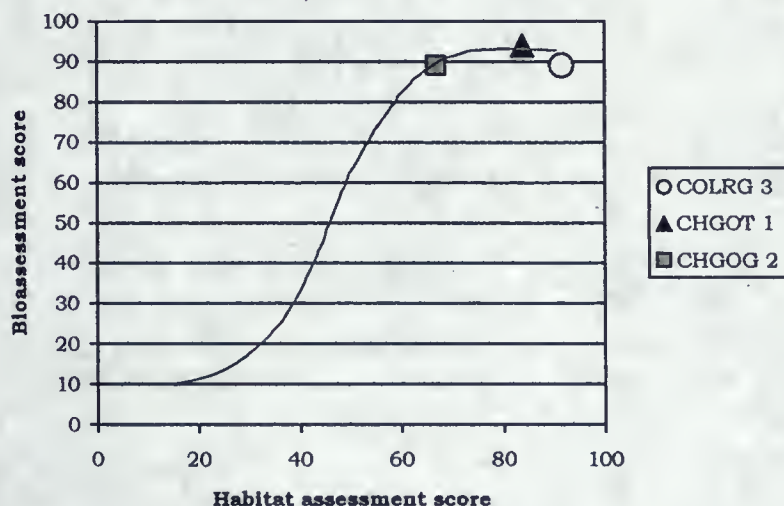
Both the upper and middle sites on Collar Gulch (COLRG 1 and COLRG 2) were judged to have relatively monotonous benthic substrate. Flow conditions were marginal at both sites. At the lowermost site on Collar Gulch (COLRG 3), all instream, streambank, and riparian zone habitat parameters were scored optimally.

At the site on the tributary to Chicago Gulch (CHGOT 1), instream and streambank parameters scored optimally or sub-optimally, but the riparian zone width was assessed as marginal. At the lower site (CHGOG 2), instream and streambank parameters were judged to be optimal or sub-optimal, but moderately unstable streambanks with disrupted vegetative protection were noted on both sides of the channel. The riparian zone was abbreviated on both sides of the channel.

Habitat assessment vs. bioassessment

When habitat assessment scores are plotted against bioassessment scores, the resulting figure provides an opportunity to evaluate the hypothetical relationship between habitat integrity and water quality. Both factors are critical and interactive determinants of the composition and functional integrity of aquatic invertebrate assemblages. Presumably, high quality habitat, in the absence of impairments to water quality, supports functional, diverse, and sensitive invertebrate assemblages; these are assemblages that attain high bioassessment scores. Barbour and Stribling (1991) have hypothesized that diminishing habitat quality should produce predictable diminishment of bioassessment scores, when water quality is not a further insult. Figure 4 is a plot of habitat assessment scores against bioassessment scores (revised method) for the sampled assemblages of Collar Gulch and Chicago Gulch. The red line superimposed on the plot represents the hypothetical relationship between habitat quality and biotic integrity given good water quality. In this model, symbols falling in the upper right area of the graph would represent sites with high scores for both bioassessment and habitat assessment; according to this model, these would be unimpaired sites both in terms of habitat integrity as well as water quality. The plot in Figure 4 places all studied sites in Collar Gulch and Chicago Gulch for which reliable bioassessment scores could be calculated in this region.

Figure 4. Total bioassessment scores plotted against habitat assessment scores for sites on Collar Gulch and Chicago Gulch. August 18 - 20, 2003. (Barbour and Stribling 1991).



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